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PAINTS FROM SOYBEAN OIL[1]

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Our work with soybean oil in the protective coatings field began at Urbana, Ill., in the fall of 1936. We inherited the exposure test fences at the South Farm of the University of Illinois which had been constructed and used for testing the durability of interior and exterior paints containing up to 35 percent of soybean oil. These paints were experimental ones made by various manufacturers at the request of Dr. W. L. Burlison, a pioneer in the soybean field, not only in agronomy, but also in the field of industrial utilization. His work with interior paints began in 1931, and with exterior paints in 1932. The paint panels, prepared under his supervision, served the dual purpose of determining the relative durability of paints containing soybean oil and those containing linseed oil only, and of demonstrating to manufacturers and the general public that soybean oil was not injurious in paints.

The Laboratory at Urbana manufactured its own paint products from raw materials, simulating commercial practice. We utilized soybean oil either in blends with other oils, such as China wood, perilla, dehydrated castor, and linseed oils, or often as the sole oil vehicle. Our first achievement at Urbana was making a hard-drying varnish from Bakelite Resin No. 254 with refined soybean oil as the only oil. By cooking the resin and oil at 600° F. we were able to make this varnish in an hour, and when thinned and treated with cobalt drier, this varnish dried hard enough in 24 hours for sanding or rubbing to surface, just as a short-oil rubbing varnish does. Also, this varnish proved not only extremely durable in weathering tests, but it was very resistant to acids, alkalies, alcohol, gasoline, and both hot and cold water. This varnish received considerable publicity, especially from the Scientific Section of the National Paint, Varnish, and Lacquer Association.

Another achievement at Urbana was the making of exterior white paints from 100 percent refined soybean oil and pigment blends of basic carbonate lead and zinc oxide. These paints were rated for durability by weathering tests in comparison with similar paints containing 100 percent linseed oil, and with a 50-50 blend of soybean and perilla oils. To make the tests more difficult for soybean oil, which does not dry as fast as linseed, we prepared our panels by giving them 3 coats, and allowed a drying time of only 24 hours between coats before starting the exposure tests. After almost 4 years of exposure, the results, published in Oil, Paint, and Drug Reporter (August 25, 1941) showed:

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[1] Presented at Cooperative Soybean Oil Mills Conference, Northern Regional Research Laboratory, May 25-27, 1948.

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1. Exterior white paints containing 100 percent soybean oil as the oil vehicle, made in accordance with the above formulations and containing 28 percent of oil by weight, were equal to similar linseed oil and blended perilla-soybean oil paints in resistance to chalking or to surface checking.

2. Similar comparisons of paints with 38 percent of oil by weight showed that all the 100-percent soybean oil paints were slightly superior to the other two oil paints in resistance to chalking but slightly inferior in surface checking of the paint films.

3. Similar comparisons of paints made with 48 percent of oil by weight showed that all the paints containing soybean oil weathered away by chalking more rapidly than similar linseed oil paint films but that the latter films became brittle as shown by their checking and particularly by the chipping of the film from the 40-percent zinc oxide paint.

   It should be noted that paints containing 48 percent of oil by weight are considered by many authorities to make the best wood-priming coats, and for this purpose the paints containing all or half soybean oil may be considered as superior to paints with all linseed oil. Paint films of the former do not become checked or brittle like those resulting from use of linseed oil paint.

4. The above paints made with 100 percent soybean oil have shown very satisfactory durability after nearly 4 years of continuous exposure tests, even though tested under an air-drying schedule of 24 hours between coats, and 48 hours' air drying before exposure. This drying schedule was intended as a very severe test for soybean oil in paints, and the above results show that paints made with 100 percent soybean oil, or with blended soybean-perilla oils when correctly formulated with the proper pigments and driers are equal in durability to similarly formulated linseed oil paints, even when the paints are air dried on the very short schedule of only 24 hours between coats.

Another paint made at Urbana from 100 percent soybean oil was white "traffic marking" or "line" paint. This type of paint must dry very rapidly, within 15 to 30 minutes, and must remain white over a bituminous road bed. We found that bodying refined soybean oil with maleic anhydride produced a heavy bodied oil which, when thinned and blended with a resin, could be pigmented to produce a durable, fast-drying road-marking paint. This paint passed tests conducted by the Ohio State Road and Highway Commission. Fast-drying and durable red barn paints have also been made from this type of treated oil.

One criticism of paints containing large quantities of soybean oil has been that the coatings pick up and retain dust and dirt to such an extent that they become unsightly in service. This condition, caused by tackiness or stickiness of the film, is noted especially when the pigment content of the paint is basic carbonate of white lead. There are two kinds of tack, one called residual which remains on the film surface and another, called after-tack, which is caused by the film softening or becoming liquid again as the result of exposure to sun heat, humid weather conditions, or for other reasons. These tack conditions cause the collection and retention of dirt in the same way that fly paper retains flies. It has been our experience that certain pigment formulations, together with high pigment volume in the paint, can be utilized for making paints containing no other oil than soybean, and that the coatings from these paints will be free from dirt collection and retention when exposed to weathering tests.

Recently we found that the addition of small amounts of calcium oxide or lime to paints containing principally refined soybean oil caused the coatings of these paints to dry without residual or after-tack. These coatings, when exposed to weathering during the hottest days in July, were found to be exceptionally free from dirt retention and discoloration. In addition, we have noted that the durability of the coatings has been improved when lime was used in the paint. On comparative tests both by accelerated and by outdoor exposure we have found that checking, cracking, and chalking have been greatly retarded when the pigment of the paint coating contained 5 percent by weight of lime. The results to date on the improvement of paint coatings through the addition of lime may mean that paints having 100 percent soybean oil vehicles can be made from the poorer drying pigments, and that their coatings will dry satisfacotirly and remain clean and durable in service.

The future of soybean oil in the protective coatings field will probably be determined by the demand for edible soybean oil. If a shortage continues in the world supply of edible oils, then less soybean oil will be available in the drying oil field, just as during the recent war. The amount of soybean oil going into the drying oil field has increased greatly since the war, most of it going into the manufacture of alkyd varnishes for use in enamels and paints. The considerable amount used in paints is in mixtures with linseed oil, although a few 100-percent soybean oil paints are available on the market. Today there is much research activity for improving the drying qualities of soybean oil, such as reacting either the oil or its fatty acids with various chemicals to give special oils tailored for specific purposes, and also fractional separation of the fatty acids by distillation or by crystallization in the cold. The separation of soybean oil into two fractions by furfural or by liquid propane seems to give great promise for the proper utilization of soybean oil. This separation gives one fraction that is more suitable for edible purposes and another that is more suitable for coating purposes. Our tests have showed that paints from the more-unsaturated fractions are equal or superior to paints from linseed oil in drying qualities, color retention, and durability.